

Atoms and Ions

1) a) State the charges of ALL three ions, Ca^{2+} , F^- and K^+ in terms of electron arrangement and number of protons.

b) Use their positions on the periodic table to explain why two of the atoms form ions with the same charge, AND two of the atoms form ions with the same electron arrangement.

2) a) Explain why the ions formed by sodium and oxygen both have the same electron arrangement.

In your answer you should:

- describe an ion
- describe the atomic structures of a sodium ion and an oxide ion
- state the charge on the sodium ion and the oxide ion
- explain the charges on both ions in terms of electron arrangement and number of protons.

b) Element X is between numbers 11 and 18 on the Periodic Table. An atom of element X forms an ion. This ion combines with the hydroxide ion to form a neutral compound, $\text{X}(\text{OH})_3$. Determine what element X is and justify your answer.

In your answer you should:

- consider the ratio of X ions to hydroxide ions
- use the formula $\text{X}(\text{OH})_3$ to determine the charge of the X ion
- explain how you would use the Periodic Table in your Resource Booklet to find out which group element X is in
- name element X.

3) a) Magnesium and calcium atoms both form ions with a charge of +2. Magnesium atoms form Mg^{2+} ions, and calcium atoms form Ca^{2+} ions. Explain why magnesium and calcium atoms form ions with the same charge of +2. In your answer, you should:

- define an ion
- explain why atoms form ions
- identify the group on the periodic table where the two atoms are found
- explain why both magnesium and calcium ions have a charge of +2.

b) Sodium and beryllium atoms form ions with different charges. Complete the table below.

Element	Periodic table group number	Electron arrangement of atom	Charge on the ion that the atom forms
Sodium			
Beryllium			

c) Explain why the ions in sodium hydroxide combine to give the formula NaOH but the ions in beryllium hydroxide combine to give the formula $\text{Be}(\text{OH})_2$. In your answer, you should:

- compare the charges on the individual ions found in the compounds sodium hydroxide and beryllium hydroxide
- explain why the ions combine in the ratios the way they do to form the compounds NaOH and $\text{Be}(\text{OH})_2$.

d) Explain why Li is a neutral atom. In your answer, you should fully describe its atomic structure and state the electron configuration.

4) Aluminium reacts with oxygen to form aluminium oxide. The formula of aluminium oxide contains two aluminium ions and three oxide ions. Discuss why the formula has two aluminium ions and three oxide ions. In your answer you should:

- State the formula for aluminium oxide.
- State the electron configuration of the aluminium atom, the oxygen atom, the aluminium ion, and the oxide ion.
- Use the electron configurations and numbers of electrons lost or gained when forming ions to justify the formula of aluminium oxide.

You may support your answer with diagrams.

5) a) Explain why carbon (C^{12}) is a **neutral** atom. You should describe the atomic structure, and state the electron configuration.

b) Explain how the particles within an atom contribute to its overall **mass**.

c) Discuss how the **mass** of nitrogen (N^{13}) compares with carbon (C^{12}).

6) a) Oxygen atoms are made of protons, neutrons, and electrons. One type of oxygen atom can be represented as ${}_8O^{18}$.

i) Draw a diagram to show the arrangement of the electrons, protons, and neutrons within the above oxygen atom

ii) Explain, with reference to the diagram, why the atom is neutral.

b) Use the table of ions in the Resource Booklet to fill in the missing name or formula for each of the compounds below.

Scientific name	Formula
(i)	$FeSO_4$
Ammonium nitrate	(ii)
(iii)	KNO_3
Calcium hydrogen carbonate	(iv)

c) Both potassium and magnesium form compounds with hydroxide ions.

i) Complete the table below for potassium and magnesium:

Element	Periodic Table Group Number	Electron arrangement of atom	Charge on ion that forms
Potassium			
Magnesium			

ii) Discuss why potassium hydroxide has the formula KOH, while magnesium hydroxide has the formula Mg(OH)₂. Refer to:

- the information in part (i)
- the changes in the electron arrangements of potassium and magnesium when they react.

7) a) The element potassium can be represented as shown below. ${}^{39}_{19}\text{K}$

i) How many protons, electrons and neutrons are in the element potassium shown above?

ii) Name the two particles found in the nucleus.

iii) The electron arrangement for the element carbon can be written 2, 4 Write the electron arrangement for the element potassium.

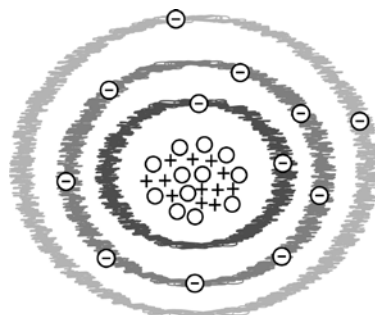
b)i) Give the formula of zinc oxide potassium sulfate calcium hydrogen carbonate

ii) Name the following compounds Cu(OH)₂ PbS MgCl₂

c)i) State the charge on the iron ion in the compounds Fe₂O₃ FeCl₂ Fe₂(CO₃)₃

ii) Explain why the charge on the ion of element X in X(OH)₂ is 2⁺.

8) The diagram below represents a model of a magnesium atom, ${}^{24}_{12}\text{Mg}$.



The symbols in the diagram above represent the proton, electron and neutron.

a) Write the appropriate symbol from the diagram and what it represents - proton, electron or neutron

b) i) Using similar symbols, draw a diagram that shows a sodium atom

ii) Discuss the similarities and differences between a sodium atom and a sodium ion. You should consider the number of protons, electrons and neutrons, and the charge of each particle.

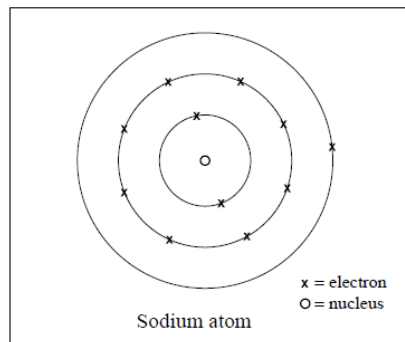
c) Name the compound $\text{Pb}(\text{NO}_3)_2$ Refer to the Table of Ions in the Resource Booklet

d) Write the formula for potassium sulfide

e) i) How many atoms are there in $\text{Al}(\text{OH})_3$?

ii) How many atoms are there in $2\text{Al}(\text{OH})_3$?

9) a) The diagram below can be used to represent the arrangement of electrons in levels around the nucleus of a sodium atom.



i) The atomic number of sodium is 11. How many protons are there in the nucleus of the neutral atom?

ii) How many neutrons are there in a sodium atom with a mass number of 23?

iii) How many electrons does a sodium atom lose to form a sodium ion?

b) A neutral oxygen atom has 8 electrons in the arrangement 2,6.

i) What is the atomic number of oxygen?

ii) How many electrons does oxygen gain to form an oxide ion?

iii) Draw a diagram like the one above for the arrangement of electrons around the nucleus of an oxide ion.

d) Use the table of ions in the Resource Booklet to work out the formulae for the following compounds.

Potassium oxide

Magnesium nitrate

Calcium sulfide

Ammonium sulfate

e) Name these compounds: CuCl_2

$\text{Zn}(\text{OH})_2$

KF

f) Refer to the positions of oxygen and fluorine in the Periodic Table provided in the Resource Booklet.

Comparing oxygen and fluorine, discuss how the electron arrangement, the atoms' positions in the Periodic Table and the charges on their ions are related.

10) a) **Complete** the table below by putting the appropriate numbers in the boxes (i) – (vi).

Symbol	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Al	13	27	13	(i)	(ii)
C	(iii)	12	(iv)	6	6
Na^+	11	23	11	(v)	12
O^{2-}	8	16	(vi)	10	8

- b) The electron arrangement for nitrogen (N) is 2,5. Write the electron arrangement for: Li P Mg^{2+}
- c) Compare the positions of sodium (Na), potassium (K) and rubidium (Rb) on the Periodic Table. (i) What is the charge on a rubidium ion? (ii) Explain.

- d) i) How many atoms of **oxygen** are there in the formula $\text{Mg}(\text{HCO}_3)_2$? What is the **total** number of atoms in the formula?
- ii) Using the Table of Ions provided in your Resource Booklet, write formulae for: calcium oxide copper hydroxide sodium carbonate
- iii) Name each of these compounds: MgO Na_2S $\text{Ca}(\text{NO}_3)_2$

- e) The doctor told Miriam she was tired and pale because she was low in iron. The iron tablets Miriam was given to take did not look like the iron nails they used in woodwork. Discuss how the **chemical** differences between the iron in the tablets and the iron in the nails are related to their uses.